Activity #7: Math: Quadratic Equation Model (Teacher version)
(Graphing Calculator)
Note to students: Teams of two or three students are required for this activity. Your
work and answers are to be made in the provided answer spaces (use additional
paper if needed) with the required graphs attached and labeled.

This activity is an adaptation and extension of the activity in <u>Advanced Algebra</u>,
Chapter 5, Prentice Hall ©1998.

National Standards addressed:
Content Standard:
Algebra Expectations: Students will use symbolic algebra to represent and explain
mathematical relationships; students will judge the meaning, utility, and reasonableness of
the results of symbol manipulations, including those carried out by technology; students will
draw reasonable conclusions about the situation being modeled.
Process Standards:
Problem Solving Expectation: Students will build new mathematical knowledge through
problem solving.
Reasoning and Proof Expectations: Students will recognize reasoning and proof as
fundamental aspects of mathematics; students will make and evaluate mathematical
arguments and proofs.
Communication Expectations: Students will organize and consolidate their mathematical
thinking through communication; students will communicate their mathematical thinking
coherently and clearly to peers, teachers, and others; students will analyze and evaluate the
mathematical thinking and strategies of others.
Connections Expectation: Students will recognize and apply mathematics in contexts
outside of mathematics.

Purpose: To understand better the quadratic equation
              To recognize a possible quadratic curve
              To generate the equation from data collected using technology
              To recognize phenomena that might generate these curves

Materials: TI graphing calculator, computer, TI-Graph Link, large plastic soda
bottle, masking tape, metric ruler, stopwatch, funnel, water, large bowls

Equipment Setup:

1. Attach a piece of masking tape from the
bottom to the top of the soda bottle as shown.
2. Make a small hole in the bottle through
 the masking tape about 5cm from the bottom
 of the bottle.
3. Put a piece of masking tape over this hole.
4. Place the bottle in the bowl.
5. Fill the bottle with water as shown.
6. Mark this water height on the masking tape.

masking tape

drain hole

watertight container
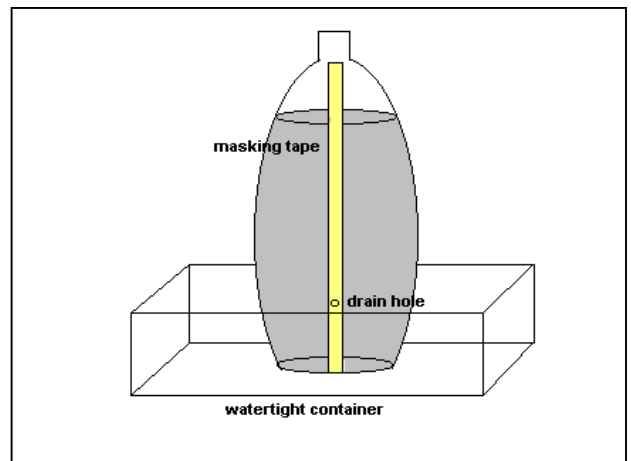
Experiment Procedure:
You will be recording water height every 5 seconds (10 seconds or other suitable interval, depending on the size of the drain hole) by marking the water height on the masking tape. When ready to begin, pull the masking tape from the hole and begin the timing. After 5 seconds, one team member will signal the end of that time interval and the other member will mark the water height on the masking tape. Continue until the water height reaches zero (the level of the drain hole). Remove the tape and measure the water height at each 5-second interval. Complete the table. Extend the table, if necessary.

| time (s)	0										
water height (mm)											

Data Analysis:
1. Enter the time values in List1 and the water level values in List2 on your calculator.
2. Do a StatPlot using these two lists and printout your graph.
3. Decide which family(ies) of functions might be used to model the data you collected.
4. Perform a quadratic regression using List1 and List2.
5. Enter this equation as function y_1 and graph. Printout your graph and your function y_1.
6. Write a paragraph describing this experiment and what you learned about modeling real world phenomena. What does the data and the mathematical model you found tell you about the rate at which the water flows from the bottle? Is it constant or does it change and if it changes, how?

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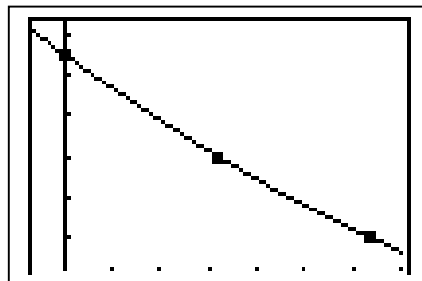_____
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Extension:
If you think another function might better model the data, repeat steps 4 and 5 using that regression. Printout this new model and tell why you feel it better models the data. How do these two models relate? Hint: Notice the domain values!

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(Sample work:
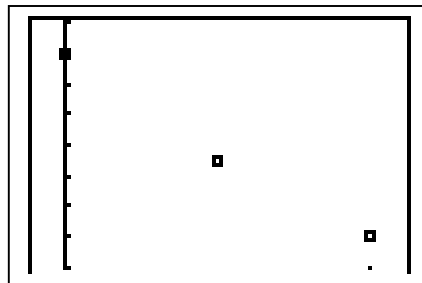
Students should describe the flow of water as changing, faster at the beginning.)

The following web sites and articles may provide enrichment and support for this activity:
1. http://unr.edu/homepage/lamberth/181suxpc.pdf
2. http://www.mste.uiuc.edu/dildine/sketches/parabolas.htm
3. http://www.krellinst.org/UCES/archive/resources/conics/node52.html
4. http://mathforum.org/key/nucalc/parabola.html
5. http://library.thinkquest.org/12006/S-M-1.shtml
6. http://www.space.gc.ca/csa_sectors/space_science/microgravity_sci/means/
7. http://nasaexplores.com
8. Advanced Algebra, Chapter 5, Prentice Hall ©1998
9. http://dl.clackamas.cc.or.us/wqt121/unit-6-math.htm